REVISTA CÁTEDRA

Impacto del uso de las TIC como herramientas para el aprendizaje de la matemática de los estudiantes de educación media

Impact of the use of ICT as tools for learning mathematics for high school students

Jorge Revelo-Rosero
Universidad UTE, Quito, Ecuador
jorge.revelo@ute.edu.ec
https://orcid.org/0000-0002-2756-4856

Sonia Carrillo-Puga
Universidad Técnica de Machala, Machala, Ecuador
scarrillo@utmachala.edu.ec
https://orcid.org/0000-0001-5026-8468

(Received on: 02/08/2018; Accepted on: 16/08/2018; Final version received on: 02/09/2018)

Suggested citation: Revelo-Rosero, J. y Carrillo Puga, S. E. (2018). Impact of the use of ICT as tools for learning mathematics for high school studentes. *Revista Cátedra,* 1*(1*), 67-87.

Resumen

En la última década existe un gran debate sobre el impacto que tiene el uso de las Tecnologías de la Información y de la Comunicación (TIC) en el ámbito educativo. La tendencia mediática y el uso masivo de tecnologías (computadores, teléfonos inteligentes, tabletas, PDA, laptops, entre otros) con conexión a Internet, son tendencias que generan cambios en el modo de aprender y acceder al conocimiento en una sociedad digitalizada. El estudio presentado es un diseño de investigación no experimental descriptivo con un enfoque cuantitativo, con una muestra de 121 estudiantes y 29 profesores de área de matemáticas de nivel medio de las unidades educativas de las provincias de Pichincha, Guayas y el Oro; pretende aportar evidencias empíricas sobre el nivel impacto que tiene la integración de las TIC como herramientas para el aprendizaje de la matemática de los estudiantes de educación media. Los resultados muestran que el papel de la tecnología e Internet en el aprendizaje de la matemática pueden generar alguna motivación, no representan para los estudiantes y docentes un factor significativo ni de alto impacto en el

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aprendizaje de la matemática a largo plazo, no por su uso o acceso a ellas, sino por la falta de competencia para aplicarlas en su aprendizaje.

Palabras clave

Educación media, educación tecnológica, formación del profesorado, matemáticas, TIC

Abstract

In the last decade, the debate about the impact on the use of Information and communication technologies (ICT) in education has educational field has increased. The media trend and the massive use of technologies (computers, smartphones, tablets, PDAs, laptops, among others) with Internet connection are trends that generate changes for learning and accessing knowledge in a digital society. This study is a design of non-experimental descriptive research with a quantitative approach, with a student and teachers sample: 121 students and 29 teachers medium level mathematics from the educational institutions from Pichincha, Guayas and El Oro; which aims to provide empirical evidence about the level of impact of ICT integration, tools used for learning mathematics for middle school students. The results show that the role of technology and the Internet in the learning of mathematics can generate some motivation, they do not represent for the students and teachers a significant factor or high impact in the long-term learning of mathematics, not for its use or access to them, but for the lack of competence to apply them in their learning.

Keywords

High school, ICT, mathematics, teacher training, technology education

1. Introduction

This article aims to determine the integration impact of information and communication technologies (ICT) as tools for the learning of mathematics in middle-school students of Ecuador. In this sense, it is necessary to consider that all teaching has an educational target, education should provide the human beings not only conditions for their cognitive formation, development of their thought, of their capacities and abilities, but also for the formation of the different aspects of their personality.

This century characterizes by the accelerated scientific and technological development, in which our society is in a profound process of structural transformation in relation to the global economy, politics, culture and the environment; especially with the digital revolution of ICT becoming more and more specialized. In short, these facts are related to the diversity of worldviews, identities, knowledge and expressions in a complex and permanently changing universe; especially with the ways of teaching, learning, communicating and working.

The knowledge society is a society of people, not of technologies (Castaño, 2006), is characterized by the constant and accelerated change of the knowledge assisted by the rapid progress of the ICT that facilitate the creation, distribution and manipulation of the information, causing that the knowledge acquired during training can be quickly obsolete (Adell, 1997; Cano, 2007; González, 2009), in which Internet plays an essential role in the economic, social, political and cultural transformations of the society (Castells, 2010). A society in which the conditions for generating, processing and transmitting knowledge-

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based information have been substantially altered by the ICT-centric technological revolution, mainly in computers and digital networks (Romeu, 2011).

In this context, ICT evolution is impacting education. In this scenario, educational institutions of all levels have the commitment to re-establish new educational priorities, guiding the concept of education and its pedagogical approaches towards a holistic and integral vision of the educational work. This process involves the continuous and permanent training of teachers in integral competencies and capacities, key factors for their integration in the teaching of mathematics. Therefore, the new role of the teacher, and particularly those of mathematics, plays a leading role to achieve meaningful learning in the students.

2. Revission of the literature

The evolution of ICT has impacted the world of education; therefore, technology has provided a wide range of resources available to support the learning of mathematics (Revelo, Revuelta and González-Pérez, 2018). The presence of ICT inside and outside of the classroom has undergone huge changes in the current educational system. The challenges and demands by the educational institutions determine the relevance of some factors, to have a quality education intended to attend to the current complexity. Thus, the role to play for ICT in the educational process is relevant as they provide the possibility of easing and improving processes that directly affect learning, school organization or communication with the community, among others (González-Pérez and De Pablos, 2015). In this context, the implementation process of ICT in the educational field depends on the technological resources that the educational institutions have, and the access facilities to insert them into the pedagogical practice. Thus, it is important to have lifelong teacher training on the mastering of digital media, in the same way, on skills and related techniques to implement innovative pedagogical practices in the classroom with ICT (Revelo, 2017).

In this context, Ecuador has oriented its educational policies to improve the quality of education by the promulgation of the Organic Law of Higher Education (LOES, 2010) and the Organic Law of Intercultural Education (LOEI, 2011). These laws are in accordance with the constitutional principles established in the Supreme Charter (2008) and international human rights instruments regulating the principles of education at the levels of initial, basic and high school education. In this context, the new challenges of the Ecuadorian state seek to train professionals and academics with capacities and knowledge that respond to the needs of national development with a humanist, solidarity-based vision, committed to the national objectives and with the good living, based on plurality and respect.

On the other hand, Art. 350, of the Ecuadorian Constitution, states that:

> The Higher Education System aims at academic and professional training with scientific and humanist vision: scientific and technological research; the innovation, promotion, development and dissemination of knowledge and cultures: the construction of solutions to the country's problems, in relation to the objectives of the development (p. 162).

In short, that would regulate and guarantee "the right to higher education, which tends to excellence..." (LOES, 2010, p. 5). In order to guarantee the development conditions and to

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achieve equity and coverage, it is a priority to invest in technological infrastructure, equipment and training in the use of ICT as pedagogical support tools for teachers (Angulo et al., 2013; Braslavsky, 2000). In this sense, the accelerated transformation that ICT have on vital habits, learning styles and ways of interaction imply different possibilities as unknown as infinite to which education should not only confront, but also give educational responses (Pérez, Castro and Fandos, 2016).

Consequently, the teacher's permanent training should be one of the main targets of the Ecuadorian State, especially now that the use of mobile technologies (smartphones, tablets, PDA, laptops, among others) by the students facilitate the implementation of more dynamic, flexible and open methodologies for the learning of mathematics. Therefore, the level of knowledge of these technological resources by the teacher provides an idea about their use to generate innovative changes within their educational practice to obtain meaningful learning in the students. Currently with the use of ICTs, the students improve their autonomy and responsibility to their own learning and contribute with their participation in the learning of the other fellow students when interacting in virtual environments of e-learning. In other words, the integration of ICT as educational innovation will contribute to the development of a digital culture through the creation of learning environments, being understood as "spaces organized for the purpose of learning; spaces that require certain components already identified: a pedagogical function (...), the appropriate technology (...) and the organizational aspects (...)" (Salinas, 2004, p. 2).

It is important to emphasize that the teacher training must be associated with the integration of ICT into the educational system, since they allow new possibilities of design and implementation of new teaching-learning methodologies as an integral part of the educational process, which seeks to enhance learning and make it more meaningful in students (Del Moral and Villalustre, 2010). In this sense, the use of ICT develops the digital competence that is part of the teaching competencies that characterize the professional profile of the professor (Carrera and Coiduras, 2012). Digital competition, being one of the basic competencies of the teacher in the 21st century, has caused the digital revolution to get to school classrooms at high speed, introducing improvements in the innovation processes in teaching and management, which has led to a change in the profile of the teacher and the student (Cabero, 2013; Cózar and Roblizo, 2014; Esteve and Gisbert, 2012; Silva et al., 2016).

As mentioned by some international institutions, the role and responsibility of the teacher is key to the use of ICTs to help students acquire and develop the necessary competencies for the 21st century (European Commission, 2006, 2012 and 2013; UNESCO, 2008 and 2011). They should be able to support the learning of their students in a digital world, able to use ICTs to improve and transform educational practices inside and outside the classroom by the use of ICT (Hall, Atkins and Fraser, 2014), what some researchers have called being competent to develop their digital competence as teachers.

3. Development of mathematical competence by using ICT

The rapid digital evolution of the increasingly specialized Web 2.0 that has transformed the Internet (Castells, 2008), as an instrument for the innovation of the teaching and learning processes, have generated new models of producing and sharing knowledge and information through the network (Mohammed and Ramírez, 2009; Tello Leal et al., 2010;

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Sangeeta, 2012). Therefore, the use of ICTs as a didactic resource allows the development of mathematical competence through real-time interaction between students and teachers, and peers in the

In order to contribute to the development of the digital competence of the math teacher, it is necessary to go beyond a simple generic definition of the competition. For this purpose, it is necessary to make contributions that have practical usefulness and transcend to the theoretical contributions. In this context, there are many ICT resources in mathematics that have been used by the teacher to improve the learning of mathematics, among them are: blogs, wikis, forums, chats, videos, social networks, etc (Basurto, 2015; López, 2011; López and Eduteka, 2003; Morón, 2013; SCOPEO, 2012).

ICT field of action	ICT/Specific Software	Digital teaching competence for the teaching of mathematics using ICT
Information management and informative literacy	Web browser (Mozilla, Internet Explorer, Google Chrome, etc.), Google, Google Drive, Dropbox, Wikipedia, Bing, wolframalpha, blogs, wikis, social networks, YouTube, Symbaloo, Delicious, Diigo, Scoop.it, Storify	• Use of browsers to search, locate and filter information, data and digital contents on specific mathematics topics. • Organize, evaluate and classify information and digital content available on the Web, for educational purposes that allow developing collaborative learning in mathematics. • Store and recover information and digital content to improve the teaching-learning process of mathematics.
Communication and collaboration	Forums, chat, blogs, wikis, social networks (Facebook, Twitter, Edmodo, Google), collaborative (Google Drive, Dropbox), multimedia content (YouTube, prezi, Slideshare, Scrtibd, Flickr), video conference, e-classroom,...	• Interaction by the management, use and application of digital communication. • Understand the proper use of different forms of communication with the digital media. • Share information and digital content with different digital media. • Citizen online participation, with the use of digital environments that promote collaborative work in mathematics. • Develop collaborative work with the use of digital channels in order to support the teaching-learning processes of mathematics.

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		• Use and manage learning activities in virtual communities and social networks in an ethical, legal and safe way, while instructing the students to have a responsible behavior in the network. Create, track and transmit your own digital identity as well as your students '.
Creating and publishing content	Blogs, wikis, social networks (Facebook, Twitter, Edmodo, Google), collaborative (Google Drive, Dropbox), multimedia content (YouTube, prezi, Slideshare, Scrtibd, Flickr), video conference, e-classrooms,... dynamic connections such GeoGebra, Cabri, Wimplot, Graph, augmented reality, wolframalpha, Mathway, fotomath... Advanced tools of Excel, free Cal Office, calculator, Derive, Wiris, WxMaxima, SPSS, communities full of mathematical resources like Descartes projects, Kahn Academy, Eduteka,...	• Application of WEB Tools 2.0 to create digital educational materials (text, presentations, images, videos, tables, conceptual maps) and share them in the network. • Create and manage spaces on the WEB 2.0 in which multimedia educational contents (images, infographics, sounds, animations, videos...) are published, information that would adapt to the learning of mathematics. • Create and manage math-specific content using: blogs, wikis, WebQuest, multimedia content (YouTube videos, Prezi, SCRIBD, Slideshare...), as educational innovation. • Know, manage and use a wide variety of manipulative dynamic connections, advanced tools, communities full of mathematical resources to adapt them to the teaching-learning needs of mathematics. • Integrate, combine, modify digital content found on the network by adjusting it to the needs and respecting the use of licenses. • Respect the legal regulations on copyright of the digital contents of the network, citing its sources. • Make changes to software, applications, configurations, programs, devices to use as educational innovation.

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	• Make modifications to the advanced digital media functions in relation to the needs of the teaching task. • Make modifications to the free software in order to improve it and adapt it to the needs of the teaching-learning process of mathematics.

Table 1. Development of mathematical competence by using ICT

3.1 Advantages and disadvantages of using ICTs in the learning of mathematics

ICTs allow students to create intuitive ideas and formal mathematical concepts, by providing an appropriate environment through interaction, visualization, interactivity; thus, facilitating learning by discovering students (López, 2010). In this context, ICTs as a didactic resource are promoting a new vision of knowledge and learning (Freire, 2007), transforming the role of the teacher into the teaching-learning process, inserting the student in the dynamics of creation and dissemination of knowledge through the network.

Alonso et al. (2010), Area-Moreira (2010), Area-Moreira and Ribeiro-Pessoa (2012), Bennett et al (2012), Buckingham (2009), Cela et al (2010), Colás and Casanova (2010), Cobo and Pardo (2007), Del Moral and Villalustre (2010), De la Torre (2006), Freire (2007), Kopcha (2012), Molina and Iglesias (2014), Pachler et al (2010), Revelo (2017), Revuelta and Pérez (2009), Romero (2008), Salinas, Benito and Lizana (2014), Santamaría (2005), Wong et al (2008), Yang (2012), Zuluaga, Pérez and Gómez (2012), and other authors have concluded that the integration of ICTs in the teaching of mathematics has multiple advantages in improving the quality of teaching, materialized in aspects such as access from remote areas, flexibility in time and space for the development of learning activities (Ferro, Martínez and Otero, 2009). ICTs also allows to search, interact, collect and process information to generate new knowledge.

	ICT in the teaching of mathematics
Types	• Blogs • Wikis • Social networks • Collaborative • Social bookmarks • Multimedia content • Other tools
Applications	• Encourage and develop written expression. • Encourage and develop spaces for discussion and exchange of information. • Reinforce classroom activities and exercises about the topics studied. • Create, search, edit, manage and publish content and information for educational purposes. • Motivate interactive participation between teachers and students.

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	• Establish integration spaces for all types of links, text, images, audio, video, presentations or animations and any other multimedia element. • Promote individual, collaborative and corporate work for participants. • Allow the construction and development of knowledge in a learning community. • Encourage and develop teacher training. • Promote and develop digital competencies in teachers and students.
Advantages	• Facilitate immediate access to the search and selection of the information available on the network from any location. • Allow to configure hypertext and multimedia content on any subject. • Allow to create, edit, manage, publish and share through the different digital communication channels (forums, chats, blogs, wikis, social networks, among others) content and information for educational purposes. • Facilitate relationships with social networks and other network applications. • Establish a rupture of space-temporal barriers in the teaching-learning activities. • Does not require great computer knowledge. • Facilitate communication and interaction between the different agents of the teaching-learning process and synchronous and asynchronously. • Promote different levels of individual or collective participation between teachers and students. • Allow a high degree of interdisciplinarity for education as it permits to break traditional teaching-learning schemes inside and outside the university classroom. • These are dynamic and encourage open and flexible training processes for the autonomous and collaborative learning of students from any place. • Allow students to think on their learning process. • Allow learning from the Feedback. • Increase the interest and motivation of students with difficulties in improving their learning process. • Facilitate the construction of knowledge in a learning community. • Encourage the development and training of teachers. • Allow to acquire digital competencies to be functional in the information and knowledge society • Encourage the participation of teachers and students in virtual communities and social networks, social and collaborative tools to promote reflection, creation, empowerment and self-development. • Immediate propagation of contents and information (RSS) that allow a better development of the network structure.

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Inconveniences	• Confidentiality of the information published on the network. • Information and content is public on the network. • A lot of content without scientific foundation or credibility sources. • Insecurity of data storage on the network. • Complete dependence on Internet access. • Changes in the conditions of the service: they can be free today but not tomorrow. • Intellectual Property Vulnerability – copyright on the content and digital information published on the network. • Ignorance and fear on the use and applications of the WEB 2.0 in educational processes by the participants. • Teaching is non-personalized. • Excess of information, which is difficult to process in its entirety

Table 2. Advantages and disadvantages on the use of ICT in the learning of mathematics

4. Objectives of the investigation

Considering the context where the research is taking place -institutions of middle education in Ecuador- the objectives are:

1. Determine the training level that teachers and students have in the use of ICT as tools for the mathematics learning.
2. Analyze the impact of ICT as tools for learning mathematics in middle school students.

To respond to the proposed objectives, the following research questions were raised:

1. Does the training level that teachers and students have in the use of ICT influence the learning of mathematics?
2. Does the integration of ICT impact in the learning of mathematics of elementary school students?

5. Materials and methods

A descriptive non-experimental research design was used with a quantitative approach that, being a formal, objective and systematic process, allowed obtaining quantifiable information about a phenomenon investigated numerically and using the statistics tests it was possible to describe, explain and test the questions posed (Bisquerra, 2004). For the data collection, a structured survey was designed as the only information-gathering instrument, in order to obtain the information related to the objectives raised. The survey presented two types of closed questions, in which the respondents were given the option of choosing Yes, No and multiple choice. The questionnaire was applied by students of the education careers of the UTE University distance education system and was the same for students and teachers of educational institutions in Pichincha, Guayas and El Oro.

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6. Population and sample

The population consisted on 458 people, out of which 423 are students of elementary school and 35 teachers of mathematics from educational institutions of Pichincha, Guayas and El Oro. For calculating the sample, the statistical formula for population sizes higher than 10 people was used, by which 150 sampling units were obtained, and were distributed as: 29 math teachers and 121 students, who were asked to respond voluntarily and anonymously the survey presented in a physical way and in order to guarantee the results and conclusions generated from the information collected in this research (see table 3).

Province	Population		Sample	
	Students	Professors	Students	Professors
Guayas	116	23	40	17
Pichincha	240	8	49	8
El Oro	67	4	32	4
Total	423	35	121	29

Table 3. Probabilistic strategy to select the sample

7. Planning and application of the field work

Phase I: At this phase the presentation of the research project divided into three qualification plans is determined. Once approved, it is proceeded to search and review the specific literature related to the research topic in some databases such as Education Resource Information Center (ERIC), Scientific Electronic Online Library (SciELO), Dialnet, Google Academic, Thesis in the Network (TDR), Online doctoral theses (TDX), Doctoral theses from 1976 (Theseus), Scopus (Multiplidisciplinar), Host Research databases (EBSCO), Digital Library of the OEI, Library of UEX, Eduteka, specialized journals, among others. This stage of research started on April 2016.

Phase II: It is determined by the definition of a non-experimental and qualitative research design, focused on a descriptive survey and the definition of the survey as a technique for collecting information that seeks to respond to objectives.

Phase III: The survey is designed, the population and sample are defined. The technique applied for the selection of the sample is probabilistic, therefore, to calculate the representative sample of the population the statistical formula was used. "Probabilistic samples are essential in transversal research designs, both descriptive and correlational–causal" (Hernández Sampieri et al., 2010, p. 177). Given the characteristics of the research, all the elements of the population have the same probability of being elected. Once the questionnaire was established, it was applied physically by students of the education careers of the distance education system of UTE University, and it was the same for students and teachers of educational institutions of Pichincha, Guayas and El Oro, prior authorization of the academic authorities and approval of students and professors selected at random for further analysis and interpretation. The approximate time to answer the questionnaire was 5 to 10 minutes, and the application was on October 2016.

Phase IV: The statistical analysis and interpretation of the data collected with the instrument developed for this research were performed by using the quantitative descriptive method

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of frequencies and percentages of each of the variables under study. The analysis was complemented by means of bivariate frequency distributions using contingency tables, the use of chi-square statistical tests and the contingency coefficient and a confidence level of 95% in order to determine the statistical relationship between the cross variables. The statistical program SPSS for Windows was used, version 22.0. Finally, the writing and presentation of the results started along with the discussion and conclusions of this research.

8. Results

To respond to the first research question: Does the training level that teachers and students have in the use of ICT influence the learning of mathematics?

The study sample are math teachers and students with medium level and studying at the educative institutions in Ecuador, out which 38.0% (n = 57) corresponds to Guayas, in equal percentage to Pichincha and 24.0% to El Oro (n = 36). The average profile of respondents are women 62.7% (n = 94), from which 81.9% are students and 18.1% are teachers, compared to 37.3% (n= 56) who are men, from which 78.6% are students and 21.4% are teachers. As for the academic level of teachers (n = 29), 17.2% (n = 5) have master's degrees; 55.2% (n = 16) have a bachelor's degree and 10.3% (n = 3) are graduated from high school, showing that the highest number of teachers are graduated in education. It can be observed that math teachers are interested to continue studying.

Regarding the age, most of the population studied belongs to the "Net generation" (Tapscott, 2010) or digital natives (Prensky, 2001), terms used to name the generation born after 1980, those people whose "learning preferences tend to teamwork, experiential activities, and the use of technology" (Cabra and Marciales, 2009). In table 4, it can be observed that 93.3% (n=140) of the sample analyzed in this research is less than 40 years, compared to 6.7% (n= 10) who is older than 40 years, showing that the largest number of students and teachers are digital natives and there is a not very significant number that could be considered as non-native digital, therefore, the integration of ICT to the learning of mathematics is a great challenge (Cabra and Marciales, 2009). Researchers such as Wodzicki et al. (2012), Bennett et al. (2008) and De la Hoz, Acevedo, and Torres (2015), infer that digital natives have developed skills that go hand-by-hand with the evolution of technology and the Internet; this means that there are differences between previous generations in the sense of facing other difficulties in implementing changes in their ways of learning by using ICTs.

Age	Students		Teachers	
	n	%	n	%
10 - 15 years old	50	33.3%	0	0.0%
16 - 20 years old	65	43.3%	0	0.0%
21 - 25 years old	5	3.3%	2	1.3%

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26 - 30 years old	0	0.0%	5	3.3%
31 - 35 years old	0	0.0%	5	3.3%
36 - 40 years old	0	0.0%	8	5.3%
More than 41 years old	0	0.0%	10	6.7%
Total	121	80.0%	29	20.0%

Table 4. Rank of ages of the studied sample (n=150)

For the treatment and analysis of quantitative information, the statistical program SPSS 22. was used. In order to determine the validity and reliability of the survey, the split plot technique and Cronbach's Alpha analysis were used, respectively. Items were grouped in the survey by dimensions, and once statistically debugged, the factor that includes items related to the impact level of the integration of ICT as tools for learning mathematics in students coursing elementary school showed a KMO index of 0.701 (> 0.5) and a Cronbach's Alpha of 0.694 (Alpha Std. = 0.679), which are acceptable values for this type of analysis. Teachers and students were asked to value on a Likert type scale from 1 to 5, in which 1 is the lowest score and 5 the maximum.

Table 5 indicates the answers about the items in the *training level* in *the use of ICT as tools for learning mathematics* based on their average assessment and standard deviation. The results show that the most relevant factor for teachers and students is that "they consider it necessary to receive ongoing training on the use and application of ICTs as tools for developing educational innovations and good educational practices (media = 3.39). On the contrary, the factor with the least impact is the one related to the fact that "the training level received in the educational institution about the use of ICT to innovate their educational practice in the learning of mathematics" is very little or scarce (mean= 1.54). In other words, 85.7% of the items are below an average of 3.0, which shows a clear negative trend in the training level in the use of ICTs as tools for learning mathematics. The dispersion of the scores of each item is not very large with respect to the average (global mean= 2.67), because the standard deviation is on a scale less than 1.

	II. Training level in the use of ICT as tools for learning mathematics	**Mean**	**Standard deviation**	**N**
1	Value the level of knowledge you have about the use of ICT for learning mathematics.	2.67	0.690	150
2	Do you know the technological resources that exist in your institution for the development of your educational practice.	2.77	0.670	150
3	Do you believe that the use of ICT in the classroom generates changes and innovations in the learning of mathematics.	2.97	0.634	150
4	Do you use the technological tools available in your educational institution such as computers, mobile devices, math software, Internet, etc., for the teaching and learning process.	2.91	0.780	150

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5	Is there enough support from your educational institution to incorporate technological tools as educational innovation.	2.43	0.789	150
6	Assess the training level received in your educational institution on the use of ICT to innovate your educational practice in the learning of mathematics	1.54	0.672	150
7	Do you consider necessary to receive ongoing training on the use and application of ICTs as tools for developing educational innovations and good teaching practices.	3.39	0.954	150
	Total global average	**2.82**		

*** 1 = very little; 2 = little; 3 = sufficient; 4 = enough; 5 = a lot**

Table 5. Training level in the use of ICTs as tools for learning mathematics (n = 150)

Finally, in order to answer the second question of this research, Does the integration of ICT impact in the learning of mathematics of elementary school students?

Table 6 summarizes the items related to the integration impact of ICTs as tools for learning mathematics, based on their average assessment and standard deviation. The results of the sample surveyed determined that the item (10) is the most relevant factor, since teachers and students consider that the integration of ICT will have a significant impact on the learning of mathematics (mean = 3.59), which can have a counterproductive effect in the beliefs that learning mathematics is more efficient if using ICTs. Likewise, items (17), (11) and (15) referring to the motivation for the time of use of technological resources (computer, tablets, software of mathematics, Internet, etc.) would be enough for the learning of mathematics; even though, the averages are above 3.0 it is not clearly seen in the sample studied that the use of technological resources have the expected impact to the learning of mathematics. On the other hand, item (8) whose mean = 2.39 (as the rest of the items below the average 3.0) and refers to the availability of technological resources for the development of educational practice in each of the institutions of the sample studied is is little, showing that it is a very negative factor in integrating ICT for the learning of mathematics in the educational institutions studied. On the other hand, the dispersion of the scores of each item is not very high with respect to the average (global mean = 2.91), because the standard deviation is on a scale less than 1.

III. Impact Level on the integration of ICT in the learning of mathematics		**Media**	**Standard deviation**	**N**
8	Does your institution provide technological resources for the development of your educational practice?	2.39	0.722	150
9	Is there Internet connection that facilitates your educational work in the classroom?	2.71	0.994	150
10	Do you consider that the use of ICT would improve the learning of mathematics?	3.59	0.991	150
11	Would you like to use technological resources such as computer, tablets, mathematics software,	3.29	0.945	150

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	Internet, etc., to improve the learning of mathematics?			
12	Do you think that if the math class used technological resources such as computers, mobile devices, math software, Internet, etc., learning would be more motivating?	2.67	0.953	150
13	Do you think that the use of social networks, blogs, wikis, multimedia content (videos YouTube, Prezi, Scribd, Slideshare,...), would contribute to a meaningful learning of mathematics?	2.88	0.996	150
14	Do you think that the use of social networks (Facebook, Twitter, Google Plus, etc.), blogs or pages designed by teachers would support the learning of mathematics outside the classroom?	2.75	0.926	150
15	Do you think that if you could use the computer longer your math learning would be easier?.	3.16	0.997	150
16	Using math software makes it easier to learn math rather than studying books.	2.58	0.869	150
17	The use of computer and Internet helps me to learn easily the knowledge of mathematics	3.38	0.981	150
18	The use of the computer can lessen my mathematical reasoning ability.	2.66	0.961	150
	Global Media	2.91		

*** 1 = very little; 2 = little; 3 = sufficient; 4 = enough; 5 = a lot**

Table 6. Integration impact of ICTs as learning tolos of mathematics (n = 150)

9. Discussion and conclusions

The results presented in this paper are part of a deeper investigation. These indicate that most of the teachers and students have negative opinions about the use of ICTs as tools that can contribute to the learning of mathematics. Hence, the need and importance for the training on the use and application of ICT as didactic tools to improve the quality of education, and to generate greater communication and interaction between teachers and students to propitiate collaborative learning. The training level in the use of ICT as tools for learning mathematics has an important possibility in the redefinition of pedagogical practice in education. However, ICT by having pedagogical application potentials, imply new challenges for the teacher who has students with developed skills and that go together with the evolution of the technology and the Internet.

On the other hand, the incorporation of ICTs into the educational process means adaptation and innovation, since the development and evolution of technology is a key element in today's society, although it is not the solution to educational problems. In other words, ICTs cannot change the teaching-learning processes, but they can increase their effects in the educational process. In this sense, several researchers like Molina & Iglesias (2014), Salinas, Benito, & Lyzana (2014), Padilla, Moreno, & Hernández (2015), Rodríguez (2010), Rodríguez (2015), Sosa (2015), Revelo (2017), among others, in their studies state that the incorporation of ICTs does not guarantee the transformation of educational practices that is, these alone do not modify the teaching-learning processes, but the way teachers use them in each area of knowledge so that their students improve their learning.

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Although the results of this research are not conclusive, it is clear that the integration of ICTs as tools for learning mathematics goes beyond the simple use of these new tools, which will cause substantial changes in the teaching-learning process, in the teacher's performance, in the teaching methods, etc. In conclusion, it is necessary to develop a better understanding on the use of ICTs, so that innovations in the educational field are not absorbed by technology, but are guided by the pedagogical processes that generate meaningful learning among teachers and students.

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Authors

JORGE REVELO–ROSERO holds a PhD in Teacher Training and ICTs in Education from the Faculty of teacher training of Universidad de Extremadura (Spain) in 2017. He obtained his master's degree in accounting and auditing – CPA at UTE University (Ecuador) in 2003. He obtained a degree in Education Sciences, professor of high school in mathematics and

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physics at the Faculty of Philosophy, Letters and Education Sciences, Universidad Central del Ecuador in 1993.

He is currently a tenured professor at Universidad UTE, in Quito. His main research topics include mathematics and related areas, mathematical applications for engineering and physics, research on ICT-based educational models. He is the author of several chapters of books and articles published in high-impact journals(Emerging Source Citation Index, Latindex, Redalcy, Scielo, Scopus).

SONIA CARRILLO PUGA obtuvo el título de Licenciada en Ciencias de la Educación, especialización Educación Inicial y Parvularia en la Obtuvo el título de Magister en Gerencia Educativa en la Universidad Técnica de Machala (Ecuador).

Holds a degree in education sciences, specialization in initial education and preschool at Universidad Técnica de Machala (Ecuador). She has a magister in Educational Management at Universidad Técnica de Machala (Ecuador).

She is currently a professor in the department of social sciences of Universidad Técnica de Machala (Ecuador). Her main research topics include the development of metacognitive strategy to improve the level of reading comprehension and hermeneutics. She is the author of several chapters of books and articles published in high-impact journals (Emerging Source Citation Index, Latindex).

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